

Joint Trauma System



Invasive Fungal Infection in War Wounds

Part of the Joint Trauma System (JTS) Clinical Practice Guideline (CPG) Training Series



Purpose



This presentation provides guidance on the recognition and comprehensive management of invasive fungal infection (IFI) in war wounds.

This presentation is based on the [Invasive Fungal Infection in War Wounds 04 Aug 2016 CPG \(ID:28\)](#). It is a high-level review. Please refer to the complete CPG for detailed instructions. Information contained in this presentation is only a guideline and not a substitute for clinical judgement.

Agenda



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Summary

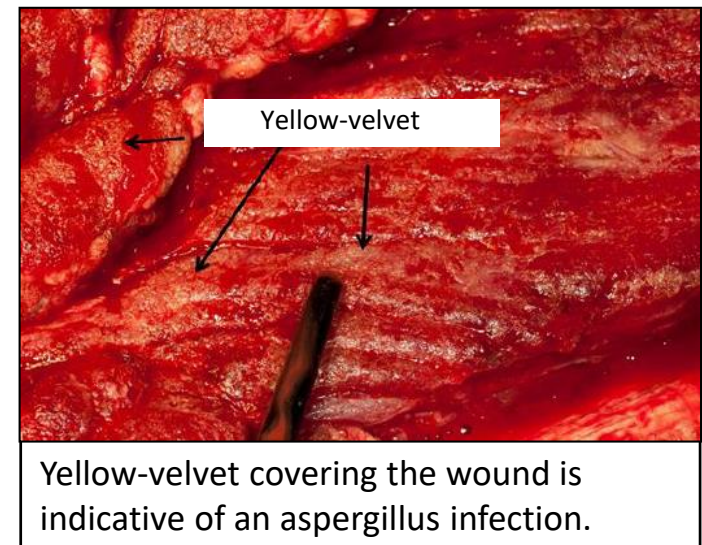


- Patients at increased risk for invasive fungal wound infections (IFIs) should have aggressive wound exploration/debridement within 12-18 hours of arrival at each facility.
- Dakin's solution is the topical agent of choice for patients at increased risk of IFI.
- Systemic antifungal agents are started and stopped based on clinical and laboratory findings.

Background

Clinically significant invasive fungal wound infections (IFIs) are part of current combat casualty care.

- IFIs are associated with increased mortality, morbidity and prolonged hospitalization for survivors.
- IFI can result in significant tissue loss by necessitating amputation or amputation revision to more proximal levels.
- Mortality rate of IFI approximately 8% in military population.



Risk Factors

Risk factors for development of IFI:

- Dismounted blast injury
- Traumatic above-knee amputation
- Extensive perineal, genitourinary, and/or rectal injury
- Massive packed red blood cell transfusion



Dismounted complex blast injury with traumatic right lower extremity amputation and perineal wound requiring massive transfusion

Topical Treatment



- Patients with 3 of the 4 risk factors for IFI should have topical antifungal therapy.
- Dakin's solution (sodium hypochlorite solution) at 0.025% concentration is primary topical therapy.
 - ❑ During first or second operative debridement, to be used in lieu of saline. Cover wounds with Dakin's solution-soaked gauze.
 - ❑ An instillation vacuum dressing may be created by placing an infusion catheter per suction port on vacuum dressing sponge.

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Topical Treatment



- ❑ An instillation vacuum dressing may be created by placing an infusion catheter per suction port on vacuum dressing sponge.
 - Hold suction for 5 minutes.
 - Instill 50 cc of 0.025% Dakin's solution.
 - Clamp catheter after 5 minutes and restart vacuum.
 - Repeat every 1 – 2 hours.
- ❑ Topical Dakin's solution can be discontinued when the treating surgeon observes healthy granulation or histopathology, and cultures are negative for fungal infection or colonization.

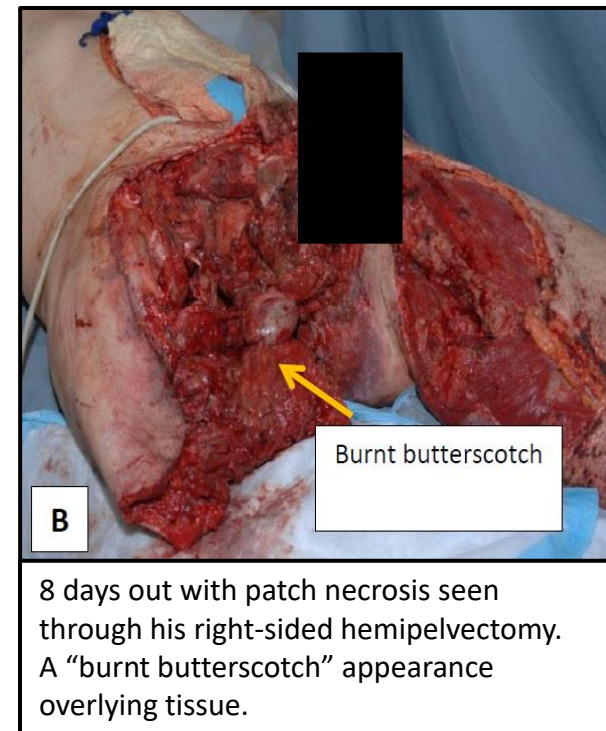
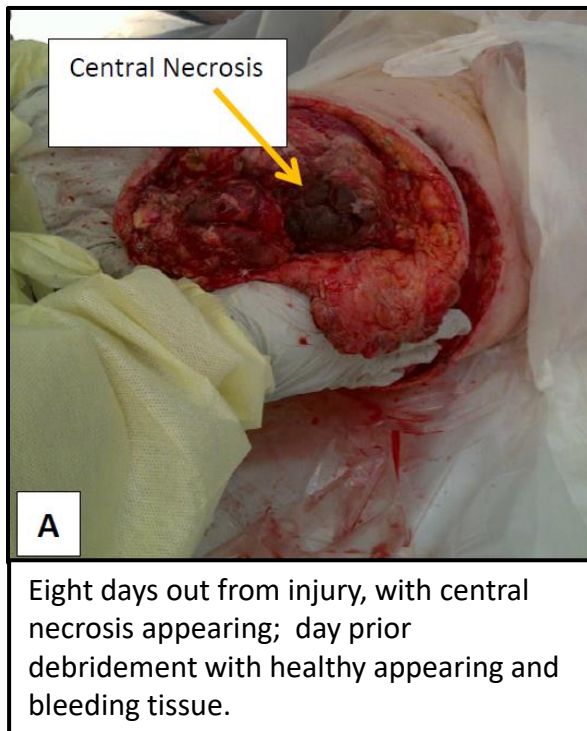
Diagnosis Criteria



- The most important aspect of evaluation is recognition of unhealthy or suspicious wounds.
- Diagnostic criteria for an IFI are:
 - ☐ Presence of a traumatic wound.
 - ☐ Recurrent necrosis following at least 2 consecutive surgical debridements.
 - ☐ Laboratory evidence of fungal infection (mold culture positivity and/or histopathology indicating tissue invasion).
- Laboratory evidence is often not available below Role 4, so clinical suspicion is key to early intervention.

IFI Examples

Examples of fungal infections (separate patients)



Debridement

- Three tenants of treatment:
 1. Debridement of infected tissue and debris.
 2. Minimization of immunosuppression.
 3. Empiric dual antifungal medications when strong suspicion of IFI.
- Early and aggressive debridement of devitalized tissue and removal of debris are the most important interventions.
- Attention should be given to aggressive debridement of non-viable tissue at each debridement procedure.



Dismounted blast injury with heavy burden of necrotic tissue and debris.

Debridement

- Document the extent of necrosis and appearance of the wound before and after completion of the operation.
- Whenever a significant amount of necrotic tissue is debrided, repeat debridement should be performed in 24 hours or less.
 - ❑ Continue repeat debridements every 24 hours until cessation of necrosis.
 - ❑ Wound coverage and closure should not occur until the wound is clean, contracting, and granulated.



Previously healthy-appearing wound bed with new tissue necrosis.

Tissue Biopsy in OR



- Biopsy for evaluation of fungal infection should be done at the time of wound exploration once the casualty has been evacuated from the theater of conflict (generally Role 4).
- Rules for biopsy:
 - ❑ Tissue samples should be obtained from each lower extremity in patients with bilateral lower extremity amputations and other sites at the discretion of the operative surgeon.
 - ❑ Compromised muscle and adipose tissue should both be sampled.

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Tissue Biopsy in OR



■ Rules for biopsy:

- ❑ At least one specimen should be taken from the junction of viable and necrotic tissue (often last piece of borderline-viable tissue removed).
- ❑ For each site sampled, two tissue specimens will be collected fresh in two separate sterile specimen containers.
 - One specimen (1 cm³) for histopathological examination.
 - One specimen (1 cm³) for fungal and bacterial culture.

OR Staff Responsibilities



- Histopathology specimens must leave the OR as fresh specimens.
- Clearly label specimens as “blast biopsy protocol” and contain the anatomic site, patient’s name, date of birth, and hospital identification number.
- Directly contact the histopathology lab or the on-call pathologist.
- OR staff must deliver the specimen as soon as possible.

Pathology Staff Responsibilities



- Wound histopathological samples require rapid processing (≤ 24 hrs).
- Histopathological samples require staining with hematoxylin and eosin (H & E) and Gomori Methenamine Silver (GMS)/ Periodic Acid-Schiff (PAS) stains and evaluation for fungal elements.
- Microbiological specimens must be cultured for aerobes, anaerobes, and fungi. Mycobacterial and/or viral cultures will only be done with special request.
 - ❑ Fungal cultures can take 6 weeks before being final.
 - ❑ Cultures growing Mucorales will have a second, non-Mucorales fungus present 30% of the time.

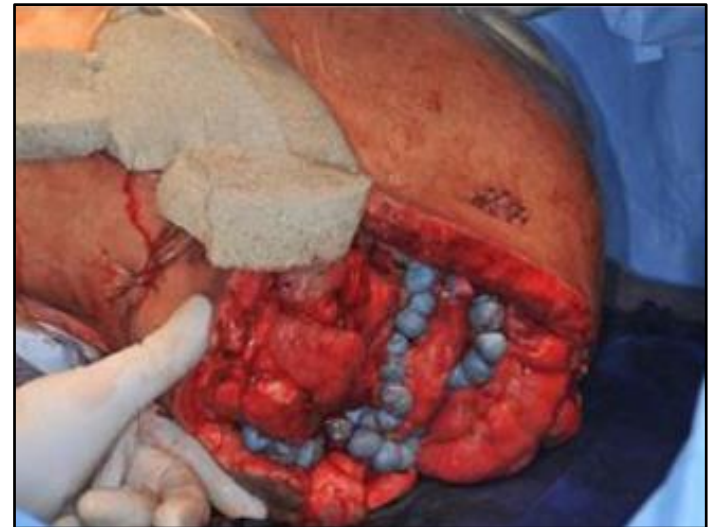
Medicinal Treatment



- If tissue necrosis is observed following two consecutive debridements (not including the first two in theater), broad spectrum antifungal and antibiotic medications should be started immediately and infectious disease consultation obtained.
- Dual agent administration of liposomal amphotericin B and a broad-spectrum triazole (e.g., voriconazole, posaconazole) recommended as first-line antifungal agents.
- Wounds often have bacterial growth as well, and broad-spectrum antibiotics covering both gram-positive and gram-negative organisms are prescribed in tandem.
- Patients are generally prescribed intravenous formulations if there is concern for inadequate gastrointestinal antifungal absorption.

Medicinal Treatment

- Topical antibacterial and antifungal beads can be used in cases of proven or strongly suspected IFI.
- Beads should be made with:
 - ❑ Liposomal amphotericin B-500 mg
 - ❑ Voriconazole-200 mg
 - ❑ Tobramycin-1.2 gm
 - ❑ Vancomycin-1 gm



Treatment with antimicrobial beads

General Guidance



- A general guide is, if the wound remains clean/viable for 2 weeks and the patient stable, stop systemic antifungal medications.
- If the patient has a fungal infection in more than 1 body region, long-term treatment may be indicated.
- If long-term treatment is required, antifungal medications should be targeted based on culture results.
- Patients transferred to Role 3 and 4 should have operative exploration, wound washout, and debridement within 12- 18 hours of arrival.
- During air evacuation, if Dakin's solution is being used via instillation vacuum dressing, it should be continued in flight.

PI Monitoring



■ Intent (Expected Outcomes)

- ☐ Casualties at risk for IFI will be identified early along the continuum of care.
- ☐ Documentation with specific attention to risk factors for IFI will be performed at each level of care.

■ Performance/Adherence Measures

- ☐ Casualties with >3 IFI risk factors are taken to OR within 12-18 hours upon arrival at Role 3 or 4 MTFs.
- ☐ Casualties with >3 IFI risk factors have Dakin's solution applied to wounds.
- ☐ Standardized operative note will be used at Role 3 facilities in theater and Role 4 facilities for casualties with >3 risk factors for IFI.

■ Data Source

- ☐ Patient Record
- ☐ Department of Defense Trauma Registry

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Appendices in CPG



- **Appendix A:** Examples of Suspicious Wounds
- **Appendix B:** MD Trauma Wound Debridement Op Note
- **Appendix C:** Bastion Classification of Lower Limb Injury
- **Appendix D:** Additional Information Regarding Off-Label Uses in CPGs

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